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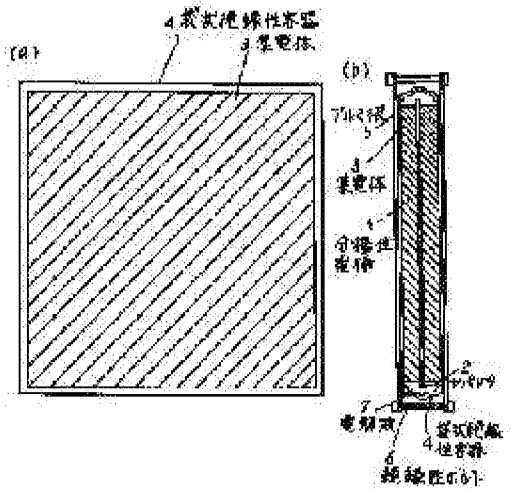
(54) ELECTRIC DOUBLE-LAYER CAPACITOR

(57)Abstract:
PURPOSE: To obtain an electric double-layer capacitor which is large in capacitance, low in equivalent series resistance, and excellent in shock resistance and mass-productivity, where the capacitor is used to instantaneously feed a large current.
CONSTITUTION: An opening is provided to a pair of opposed surfaces of large area of a polyethylene bag-like insulating case 4 whose one side is open respectively, and a conductive rubber sheet (collector) 3 of sulfuric acid-resistance is welded to the insulating case 4 by heating. A polyethylene porous separator 2 is sandwiched in between two solid-state active carbon polarizable electrodes 1, these separator 2 and tire electrodes 1 are dipped and vacuum-impregnated with electrolyte 7, the separator 2 and the electrodes 1 impregnated with electrolyte are put into the bag-like insulating case 4, and the case 4 is sealed up by welding its open side by an ultrasonic welder for the formation of an electric double-layer capacitor cell. Furthermore, two or more electric double-layer capacitor cells are laminated to form an electric double-layer capacitor.



* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1]An electric double layer capacitor which it has the following, and this charge collector made of conductive rubber and said solid state activated carbon are electrically connected, and is characterized by filling up inside of said saccate insulation container with an electrolysis solution.
It is solid state activated carbon of a couple at least.
A separator inserted between this solid state activated carbon.
A saccate insulation container which accommodates this separator and said solid state activated carbon.
A charge collector made of conductive rubber which adhered to an opening provided in a large area side of a couple of this insulating container.

[Claim 2]The electric double layer capacitor according to claim 1 which a charge collector made of conductive rubber has pasted up on an opening of a saccate insulation container with thermal melting arrival or adhesives.
[Claim 3]The electric double layer capacitor according to claim 1 or 2 which is what a saccate insulation container becomes from a bag-like object made of a product made from polyethylene, or rubber.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]Especially this invention relates to the electric double layer capacitor optimal as auxiliary power for instant high current supply about an electric double layer capacitor.
[0002]
[Description of the Prior Art]Drawing 3 shows the outline of a common electric double layer capacitor in which the activated carbon of the solid state was used to a polarizable electrode. It is made to face so that the separator 2 may be inserted in the solid state activated carbon polarizable electrode 1 of the couple impregnated with the electrolytic solution and it may not contact electrically, and fixes in one block divided by the septum in the container 10 made from VCM/PVC (a cell is called hereafter.). The activated carbon / poly acene system composite material, and the activated carbon/graphite composite material obtained by heat-treating the mixture of activated carbon and phenol system resin as shown in Japanese Patent Application No. No. 81262 [three to] as the solid state activated carbon polarizable electrode 1, What solidified activated carbon with binders, such as fluorine system resin and artificial latex, is used. The working voltage per cell is below the electrolysis voltage of an electrolytic solution. Therefore, it becomes the structure which carried out the series connection of two or more cells electrically with the connected conductors 8 for raising the working voltage of a capacitor. The terminal is picked out from the solid state activated carbon polarizable electrode located in both ends when a series connection is carried out electrically, respectively. The connected conductors 8 and a terminal have electrical conductivity and chemical resistance, and need to use material with a high mechanical strength. By the way, although the electric double layer capacitor has so far been used as small capacity auxiliary power for backup of a memory etc., it is expected also as auxiliary power for instant high current supply, such as a motor drive, these days. The electric double layer capacitor of the large scale of as [especially whose electric capacity is more than 10F] has a high possibility of being used as an object for instant high current supply. Therefore, in order to make small the voltage drop at the time of high current supply in such an electric double layer capacitor, it is necessary to make equivalent series resistance small as much as possible. The equivalent series resistance of the electric double layer capacitor using the polarizable electrode of the solid state consisted of the specific resistance and each contact resistance of an electrolysis solution, a solid state polarizable electrode, a charge collector, connected conductors, and a terminal, and each occupies it at an almost equivalent rate.

Conventionally, in order to contact an electrolysis solution within a cell, in acid resistance, the charge collector used the screw etc. for solid state activated carbon, connected this to it using the conductive carbon material, and has taken the electrical link. However, since both carbon of solid state activated carbon and a charge collector was a solid lacking in modification nature, it was difficult to stick both in a big area, and the touch area decreased, electrical resistance increased, and the equivalent series resistance as an electric double layer capacitor increased. In order to connect the parts of a scarce solid to tenacity mechanically with a screw etc., there was a problem that the obtained electric double layer capacitor was weak against vibration or a shock, and mass production nature was bad.

[0003]The purpose of this invention solves such a conventional problem, and its equivalent series resistance is low and it aims at excelling in shock resistance and providing the good electric double layer capacitor of mass production nature.

[0004]

[Means for Solving the Problem]A separator with which this invention was inserted at least between solid state activated carbon of a couple, and this solid state activated carbon, A saccate insulation container which accommodates this separator and said solid state activated carbon, Consisting of a charge collector made of conductive rubber which adhered to an opening provided in a large area side of a couple of this insulating container, this charge collector made of conductive rubber and said solid state activated carbon are electric double layer capacitors, wherein it is electrically connected and inside of said saccate insulation container is filled up with an electrolysis solution. Here, it makes it suitable to have pasted up a charge collector made of conductive rubber on an opening of a saccate insulation container with thermal melting arrival or adhesives, and makes it suitable for a saccate insulation container to be what consists of a bag-like object made of a product made from polyethylene, or rubber.

[0005]

[Function]By using as a container and charge collector in which closure made this adhere to the opening of saccate insulation containers, such as easy polyethylene, according to this invention, using conductive rubber as a charge collector. As a result of contact resistance's falling by the cross-section area of the course into which current flows increasing substantially, and using conductive rubber, equivalent series resistance can be stopped low.

[0006]

[Example]Next, the example of this invention is described.

Weighing of the powdered phenol system resin was carried out to example 1 powdered activated carbon at a rate of 6:4 (weight ratio), and it mixed by the high-speed dry type mixer for 12 hours. The 100mmx70mmx6mm Plastic solid was made from carrying out heat pressing of this mixed powder for 10 minutes at 180 **, this was heat-treated at 800 ** in the non-oxidizing atmosphere, and activated carbon / poly acene system composite material was obtained. This activated carbon / poly acene system composite material were used as the solid state activated carbon polarizable electrode. It contracted during heat treatment and the outside dimension became smaller than the time of shaping.

[0007]Drawing 1 is a sectional view (drawing 1 (b)) of the electric double layer capacitor which fixed the front view (drawing 1 (a)) of electric double layer capacitor 1 cell and this which are obtained by this example with the aluminum board 5. The manufacturing method of this electric double layer capacitor is described below. At 115 mm x 85 mm, the outside formed the opening (95 mm x 65 mm) in the both sides of the

bag-shaped container 4 made from polyethylene which the 100-micrometer-thick end opened, respectively, and produced the thing to which the thermal melting arrival of the conductive rubber sheet (charge collector) 3 of 100mmx70mmx0.5mm sulfuric acid-proof nature was made to carry out there. Subsequently, the porous separator 2 with a thickness of 25 micrometers which makes polyethylene construction material was inserted between the solid state activated carbon polarizable electrodes 1. These were dipped into 30wt% of the sulfuric acid solution which is an electrolysis solution, and the electrolysis solution was impregnated in the solid state activated carbon polarizable electrode 1 by lengthening the whole to a vacuum. The solid state activated carbon polarizable electrode 1 with which the electrolysis solution was impregnated and which inserted the separator 2 is put into the bag-shaped container 4 made from polyethylene which made the aforementioned charge collector 3 made of conductive rubber weld, Furthermore added the electrolysis solution, and it is made to fill a bag-shaped container with an electrolysis solution, and sealed by carrying out thermal melting arrival of the open end, and electric double layer capacitor 1 cell of this invention of the operating pressure 0.9V shown in drawing 1 was obtained. The aluminum board 5 which served as the terminal electrode was fixed on both sides of capacitor cells with two sheets and the insulating bolt 6.

[0008]The same result was obtained even if it used the letter insulation container of insulating rubber bag manufacture of sulfuric acid-proof nature instead of the saccate insulation container made from polyethylene by this example. The same result was obtained even if it adopted adhesion by adhesives instead of thermal melting arrival attaching the charge collector made of conductive rubber to the opening of a saccate insulation container.

[0009]It inserted and fixed with two aluminum boards and the insulating bolt which served the same capacitor cells as example 2 Example 1 as a six-sheet pile, and served the terminal electrode both as these, and the electric double layer capacitor of the operating voltage 5V was obtained. Drawing 2 is a sectional view of the electric double layer capacitor of the obtained operating voltage 5V.

[0010]As shown in comparative example drawing 3, 12 things which connected the connected conductors 8 made from carbon to the end of the solid state activated carbon polarizable electrode 1 with the screw 9 were prepared, and it inserted one pair at a time in each battery case of the container 10 made from VCM/PVC divided into six battery cases. The separator 2 made from porous polyethylene was inserted between one pair of solid-active-carbon polarizable electrodes 1 at that time. By filling 30wt% of sulfuric acid solution to each battery case as an electrolysis solution, and lengthening the whole to a vacuum, solid state activated carbon polarizable electrode 1 inside was impregnated in the electrolysis solution. The lid 11 made from VCM/PVC was put, it closed with adhesives, and the electric double layer capacitor of the operating voltage 5V was obtained.

[0011]About the electric double layer capacitor manufactured by the example and the comparative example, the equivalent series resistance and electric capacity which are the capacitor characteristic were measured. Equivalent series resistance sent 10-mA constant current through the electric double layer capacitor by 1 kHz of exchange, and searched for it by measuring the terminal voltage of an electric double layer capacitor. Electric capacity was calculated by measuring time deltat until terminal voltage will be 50% from 60% of charge voltages, when constant current discharge of the capacitor was carried out at 100 mA. When charge voltages are 5V, it is the electric capacity C,

[0012]

[Equation 1]

$C=I\times deltat/deltaV=0.1\times deltat/(3.0-2.5)$ [F]

[0013]It becomes. The equivalent series resistance and electric capacity of each example and a comparative example are shown in Table 1. Equivalent series resistance can be made or less [conventional] into 1/2 according to the example of this invention so that more clearly than Table 1. By having electrically connected each cell through the biggest field of a polarizable electrode, this has the large effect in which the cross-section area of the course into which current flows increased substantially. Otherwise, it is thought by having used conductive rubber that there is an effect to which contact resistance fell. Therefore, it turns out that the electric double layer capacitor of the structure of this invention is dramatically effective in reducing equivalent series resistance.

[0014]

[Table 1]

----------. Equivalent series resistance/omega Electric capacity / F ---------- ---------- example 1 0.030 4805 Example 2 0.210 756 Comparative example 0.450 730----------[0015]

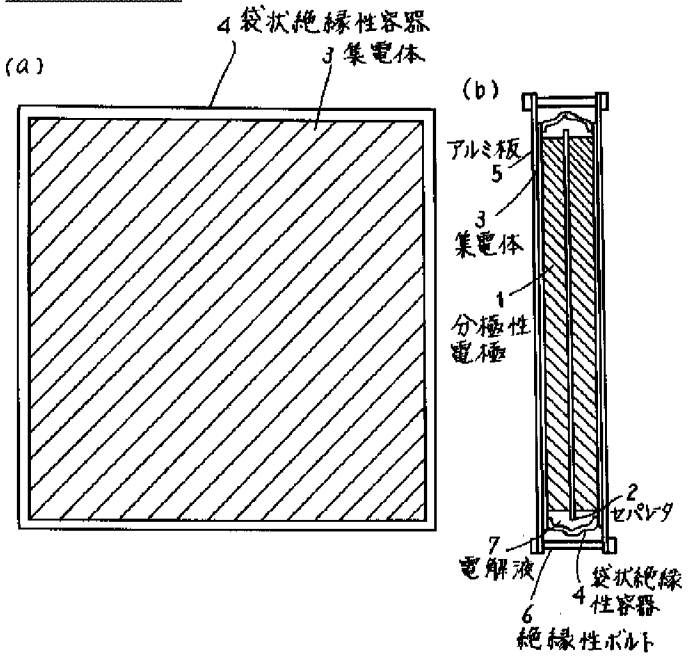
[Effect of the Invention]As explained above, according to this invention, the electric double layer capacitor which whose equivalent series resistance was dramatically low, and was excellent in shock resistance, and was excellent in mass production nature can be obtained.

[Translation done.]

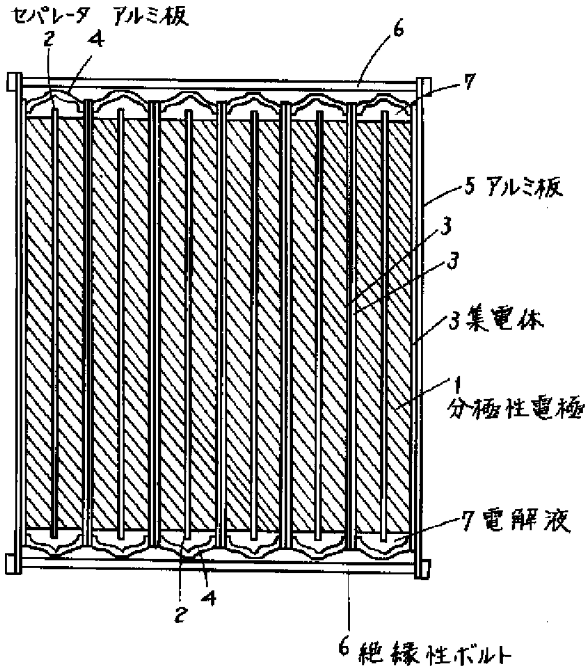
* NOTICES *

DRAWINGS

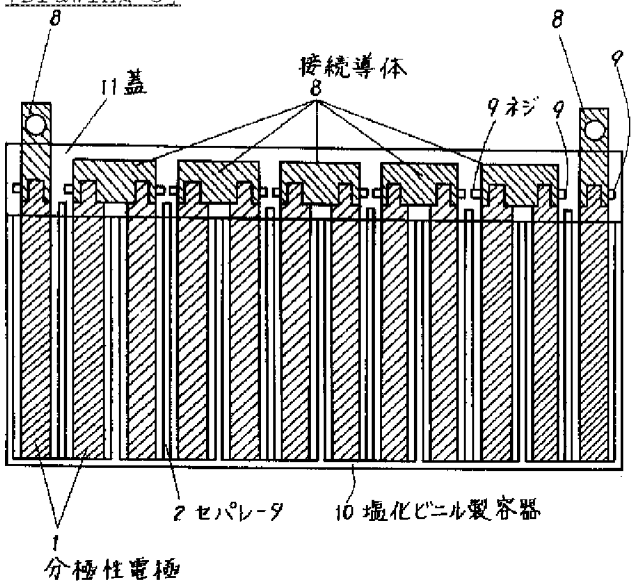
[Drawing 1]



[Drawing 2]



[Drawing 3]



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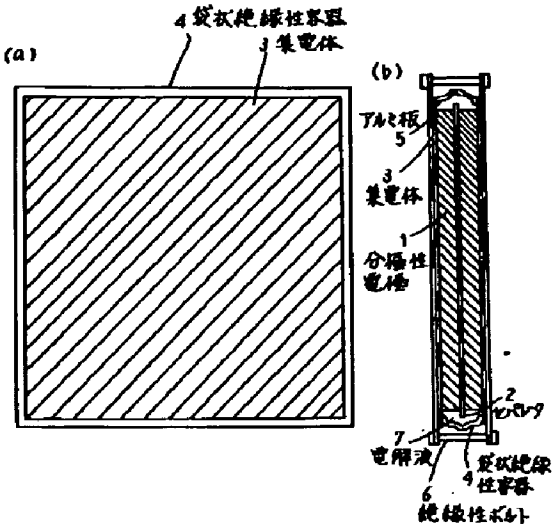
(54)【発明の名称】　電気二重層コンデンサ

(57)【要約】

【目的】　瞬時大電流供給用の大容量電気二重層コンデンサにおいて、等価直列抵抗が低く耐衝撃性に優れかつ量産性のよい構造を提供する。

【構成】　一端が開いたポリエチレン製の袋状絶縁性容器４の一対の大面積面に開口部をそれぞれ形成し、耐硫酸性の導電性ゴムシート（集電体）３を熱融着させたものを作製する。ポリエチレン製の多孔性セパレータ２を２枚の固体状活性炭分極性電極１の間に挟みこれらを電解液７に浸し、真空含浸したものを前記袋状絶縁性容器４に入れ、その開いている一端を超音波融着することにより密封し、電気二重層コンデンサ１セルを作製する。さらに複数枚上記の電気二重層コンデンサセルを重ねたものでもよい。



1

【特許請求の範囲】

【請求項1】　少なくとも一対の固体状活性炭と、該固体状活性炭間に挿入されたセパレータと、該セパレータおよび前記固体状活性炭を収容する袋状絶縁性容器と、該絶縁性容器の一対の大面積面に設けられた開口部に固着された導電性ゴム製集電体とからなり、該導電性ゴム製集電体と前記固体状活性炭とは電気的に接続され、前記袋状絶縁性容器内は電解液で充填されていることを特徴とする電気二重層コンデンサ。

【請求項2】　導電性ゴム製集電体が袋状絶縁性容器の開口部に熱融着または接着剤により接着されている請求項1記載の電気二重層コンデンサ。

【請求項3】　袋状絶縁性容器がポリエチレン製またはゴム製の袋状物からなるものである請求項1または2に記載の電気二重層コンデンサ。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は電気二重層コンデンサに関し、特に瞬時大電流供給用補助電源として最適な電気二重層コンデンサに関するものである。

【0002】

【従来の技術およびその課題】図3は、分極性電極に固体状の活性炭を用いた一般的な電気二重層コンデンサの概略を示したものである。電解質溶液を含浸させた一対の固体状活性炭分極性電極1にセパレータ2を挿入し電気的に接触しないように相対させ、塩化ビニル製容器10において隔壁により区切られた一つのブロック内に固定する（以下、セルと称す。）。固体状活性炭分極性電極1としては、特願平3－81262号に示すような活性炭とフェノール系樹脂との混合物を熱処理することにより得られる活性炭／ポリアセン系複合材料や活性炭／炭素複合材料、活性炭をふっ素系樹脂や人造ラテックスなどの結着剤で固体化したものなどが用いられている。セル1個当たりの使用電圧は電解質溶液の電気分解電圧以下である。従って、コンデンサの使用電圧を高めるには接続導体8によりセルを複数個電気的に直列接続した構造となる。端子は、電気的に直列接続したときの両端に位置する固体状活性炭分極性電極よりそれぞれ取り出している。接続導体8および端子は電気伝導性や耐薬品性を有し機械的強度の高い材料を用いる必要がある。ところで、これまで電気二重層コンデンサはメモリのバックアップ用などの小容量補助電源として用いられてきたが、最近、モータ駆動等の瞬時大電流供給用補助電源としても期待されている。特に静電容量が10F以上であるような大容量の電気二重層コンデンサは、瞬時大電流供給用として使用される可能性が高い。そのため、このような電気二重層コンデンサにおいては大電流供給時の電圧降下を小さくするため等価直列抵抗は極力小さくする必要がある。固体状の分極性電極を用いた電気二重層コンデンサの等価直列抵抗は、電解液、固体状分極性電

2

極、集電体、接続導体、端子の固有抵抗とそれぞれの接触抵抗とからなり、それぞれがほぼ均等の割合で占めている。従来、集電体はセル内で電解液と接触するために耐酸性で導電性のカーボン材料を用い、これを固体状活性炭にネジなどを用い接続して電気的接続をとっている。ところが固体状活性炭と集電体のカーボンは両方とも変形性に乏しい固体であるため大きな面積で両方を密着させることは困難であり、接触面積が減少して電気抵抗が増大し、電気二重層コンデンサとしての等価直列抵抗が増大した。また、じん性に乏しい固体の部品同士をネジなどで機械的に接続するため、得られた電気二重層コンデンサが振動や衝撃に弱く量産性が悪いという問題点があった。

【0003】本発明の目的は、このような従来の問題点を解決して、等価直列抵抗が低く、耐衝撃性に優れ、かつ量産性のよい電気二重層コンデンサを提供することを目的とする。

【0004】

【課題を解決するための手段】本発明は、少なくとも一対の固体状活性炭と、該固体状活性炭間に挿入されたセパレータと、該セパレータおよび前記固体状活性炭を収容する袋状絶縁性容器と、該絶縁性容器の一対の大面積面に設けられた開口部に固着された導電性ゴム製集電体とからなり、該導電性ゴム製集電体と前記固体状活性炭とは電気的に接続され、前記袋状絶縁性容器内は電解液で充填されていることを特徴とする電気二重層コンデンサである。ここで、導電性ゴム製集電体は、袋状絶縁性容器の開口部に熱融着または接着剤により接着されていることを好適とし、袋状絶縁性容器はポリエチレン製またはゴム製の袋状物からなるものであることを好適とする。

【0005】

【作用】本発明によれば、導電性ゴムを集電体として用い、これを封止が容易なポリエチレンなどの袋状絶縁性容器の開口部に固着させた容器兼集電体として用いることで、電流の流れる経路の断面積が大幅に増大し、また導電性ゴムを用いることによって接触抵抗が低下する結果、等価直列抵抗を低く抑えることができる。

【0006】

【実施例】次に、本発明の実施例について説明する。

実施例1

粉末活性炭と粉末状のフェノール系樹脂を6：4（重量比）の割合で秤量し、高速乾式ミキサーにより12時間混合した。この混合粉を180℃で10分間熱プレスすることで100mm×70mm×6mmの成形体を作り、これを非酸化性雰囲気において800℃で熱処理して、活性炭／ポリアセン系複合材料を得た。この活性炭／ポリアセン系複合材料を固体状活性炭分極性電極とした。熱処理中に収縮し外形寸法は成形時より小さくなった。

3

【0007】図1は、本実施例で得られる電気二重層コンデンサ1セルの正面図（図1（a））およびこれをアルミ板5で固定した電気二重層コンデンサの断面図（図1（b））である。この電気二重層コンデンサの製造方法について次に述べる。外形が115mm×85mmで、厚さ100μmの一端が開いたポリエチレン製の袋状容器4の両側に95mm×65mmの開口部をそれぞれ形成し、そこに100mm×70mm×0．5mmの耐硫酸性の導電性ゴムシート（集電体）3を熱融着させたものを作製した。次いで、ポリエチレンを材質とする厚さ25μmの多孔性セパレータ2を固体状活性炭分極性電極1の間に挟んだ。これらを電解液である30wt%の硫酸水溶液中に浸し、全体を真空に引くことで電解液を固体状活性炭分極性電極1内に含浸した。電解液を含浸しセパレータ2を挿入した固体状活性炭分極性電極1を前記の導電性ゴム製集電体3を融着させたポリエチレン製の袋状容器4に入れ、さらに電解液を足して袋状容器を電解液で満たすようにし、その開いている一端を熱融着することにより密封し、図1に示す動作圧0．9Vの本発明の電気二重層コンデンサ1セルを得た。端子電極を兼ねたアルミ板5を2枚と絶縁性ボルト6でコンデンサセルを挟み固定した。

【0008】なお、本実施例でポリエチレン製の袋状絶縁性容器の代わりに耐硫酸性の絶縁性ゴム製袋状絶縁性容器を用いても同様な結果が得られた。また、袋状絶縁性容器の開口部に導電性ゴム製集電体を取り付けるのに、熱融着の代わりに接着剤による接着を採用しても同様な結果が得られた。

4

＊【0009】実施例2

実施例1と同様のコンデンサセルを6枚重ね、これらを端子電極を兼ねたアルミ板2枚と絶縁性ボルトで挟み固定し動作電圧5Vの電気二重層コンデンサを得た。図2は得られた動作電圧5Vの電気二重層コンデンサの断面図である。

【0010】比較例

図3に示すように、固体状活性炭分極性電極1の端部にカーボン製接続導体8をネジ9で接続したものを12個用意し、6つの電槽に分かれている塩化ビニル製容器10の各電槽に1対づつ挿入した。その際、1対の固体活性炭分極性電極1の間に多孔質ポリエチレン製のセパレータ2を挿入した。電解液として30wt%の硫酸水溶液を各電槽に満たし全体を真空に引くことで、電解液を固体状活性炭分極性電極1内部に含浸した。塩化ビニル製の蓋11をかぶせ、接着剤により封止して動作電圧5Vの電気二重層コンデンサを得た。

【0011】実施例および比較例で製造した電気二重層コンデンサについて、コンデンサ特性である等価直列抵抗と静電容量を測定した。等価直列抵抗は、電気二重層コンデンサに交流1kHzで10mAの定電流を流し、電気二重層コンデンサの端子電圧を測定することで求めた。また、静電容量は、コンデンサを100mAで定電流放電したとき、端子電圧が充電電圧の60%から50%になるまでの時間Δtを測定することにより求めた。充電電圧が5Vの場合、静電容量Cは、

【0012】

【数1】

$$C=1\times\Delta t/\Delta V=0.1\times\Delta t/(3.0-2.5)\ [F]$$

【0013】となる。表1に各実施例と比較例の等価直列抵抗と静電容量を示す。表1より明らかなように、本発明の実施例により等価直列抵抗を従来の1／2以下にすることができる。これは分極性電極の最も大きな面を通じて各セルを電気的に接続したことにより、電流の流れる経路の断面積が大幅に増大した効果が大きい。ほか※に、導電性ゴムを用いたことにより接触抵抗が低下した効果もあると考えられる。したがって、本発明の構造の電気二重層コンデンサは等価直列抵抗を低減することに非常に有効であることがわかる。

【0014】

【表1】

	等価直列抵抗／Ω	静電容量／F
実施例1	0．030	4805
実施例2	0．210	756
比較例	0．450	730

【0015】

【発明の効果】以上説明したように、本発明によれば等価直列抵抗が非常に低く、耐衝撃性に優れ、かつ量産性に優れた電気二重層コンデンサを得ることができる。

【図面の簡単な説明】

【図1】本発明による電気二重層コンデンサ1セルの一例の正面図およびこれをアルミ板で固定した電気二重層コンデンサの断面図である。

★【図2】本発明による電気二重層コンデンサの一実施例の断面図である。

【図3】従来例による電気二重層コンデンサの一例の断面図である。

【符号の説明】

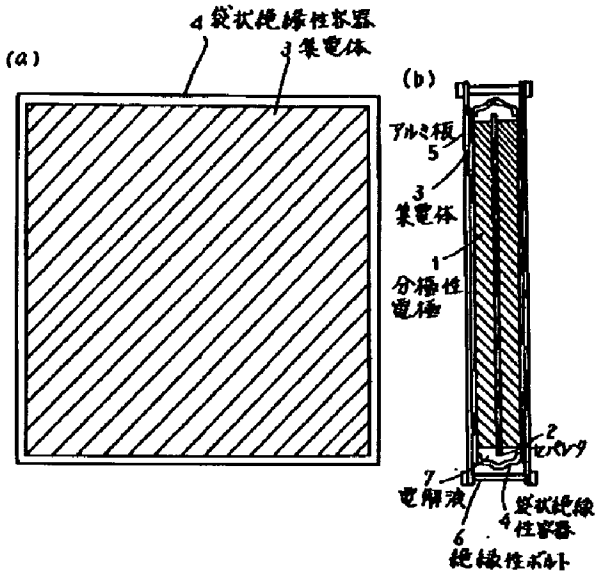
1　固体活性炭分極性電極　　2　セパレータ
3　導電性ゴム製集電体　　4　袋状絶縁性容器
5　アルミ板　　6　絶縁性ボルト

5　　6

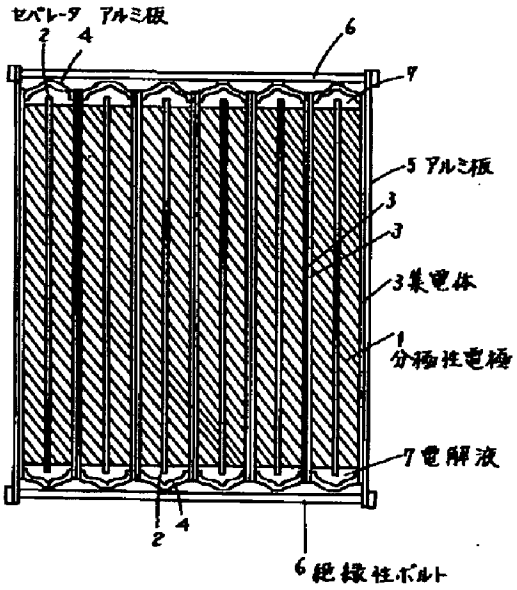
7　電解液　　8　接続導体　　器

9　ネジ　　10　塩化ビニル製容　　11　塩化ビニル製蓋

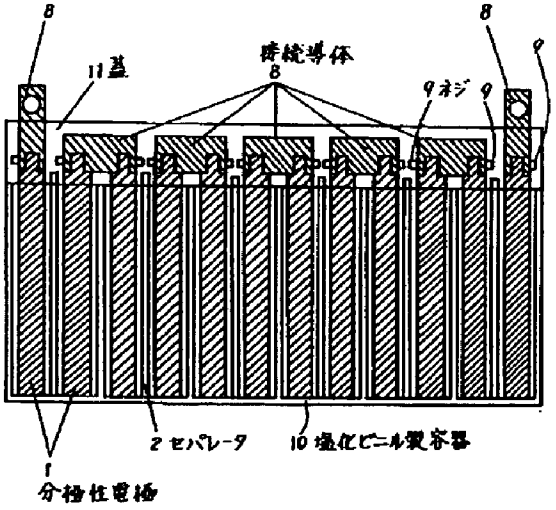
【図1】



【図2】



【図3】



フロントページの続き

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